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ABSTRACT

This report provides a description of the conceptualization and methods required to perform a cost effectiveness analysis in the field of instructional technology. The case study discussed involves a cost effectiveness comparison of four alternative systems for delivering continuing education instruction in management to several geographically separate sites. The alternative instructional delivery systems considered were: (1) live lecture, (2) interactive instructional television, (3) mediated self instruction, and (4) guided independent study. Findings are summarized in a cost effectiveness comparison matrix which compares the four methods across multiple criteria. A wealth of raw data on the four methods is also provided. (STS)

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# PROGRAM PLANNING AND THE COST-EFFECTIVENESS ANALYSIS OF INSTRUCTIONAL TECHNOLOGIES: A CASE STUDY IN PLANNING CONTINUING EDUCATION SERVICES

Richard M. Lent
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Presented in E. F. Kelly (Chair), Cost-effectiveness analysis and program planning for higher education. Symposium presented at the meeting of the American Educational Research Association, New York, April 4-8, 1977.

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Richard M. Lent
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The two other case studies presented in this symposium focus on the methodology of cost analysis. This presentation focuses on the methods of cost-effectiveness analysis, and these two kinds of analysis activities are quite different. Cost-effectiveness analysis involves more than the incorporation of various sorts of qualitative or non-financial data into the basic cost analysis. A determination of cost-effectiveness involves judging the worth of something as a means to a given end. This judgment of worth is based on a consideration of the relationship between the resources expended on something and the nature of the outcomes which are obtained as a result. It involves the simultaneous consideration of inputs and outcomes in arriving at a conclusion. A cost-effectiveness judgment is distinct from judgments of such things as efficiency, expensiveness, and impact although it may sometimes include these.

We make informal judgments of cost-effectiveness every day. At least some of you made such a judgment in deciding to get out of bed in time to attend this session. The purpose of this presentation is to review some of the problems and present a case study of the methods employed in a more

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formal consideration of cost-effectiveness: specifically the cost-effectiveness of various instructional technologies in delivering continuing education services.

## Cost-Effectiveness Analysis and Instructional Technology

Instructional technology is the field devoted to the "facilitation of human learning through the systematic identification, development, organization and utilization of a full range of learning resources and through the management of these processes (Association for Educational Communications and Technology, 1972)." Some of the more familiar applications of instructional technology include computer assisted instruction, programmed instruction, instructional television and instructional development projects. The reports of various studies on the future of instructional technology have stressed its potential ability to improve the productivity as well as the quality of educational programs (e.g. Commission on Instructional Technology, 1970; Carnegie Commission on Higher Education, 1972). Under the financial circumstances facing education today, almost any decision about instructional technology should be based on a consideration of its cost-effectiveness in achieving a particular end. To make such a consideration, however, there must be some method for evaluating cost-effectiveness.

For more than twenty years, economists, engineers, and policy analysts have devoted considerable attention to the development of techniques for conducting cost-effectiveness analyses. These methods have been successfully applied to problems in a variety of areas: particularly in business and military contexts. In the late 1960's this form of analysis began to be considered for education. As soon as educational cost-effectiveness analyses

began to be conducted, however, a number of writers began reporting particular difficulties in adapting the technique to education (e.g. Cogan, 1971; Grayson, 1972; James, 1969). Generally, these difficulties were seen to reflect the rather messy and ill-defined nature of educational decision situations as compared to the military and industrial decisions for which the technique was originally created (Quade, 1975, p.8). In a detailed critique, Levin (1971) outlined the problems facing the cost-effectiveness analysis of instructional technology and concluded that, "most of the requirements for sound cost-effectiveness analysis cannot be satisfied given our present knowledge of the educational process (p. 1000)." Levin went on to explain that he does not argue against the conduct of cost-effectiveness studies, but only that it is necessary to recognize the difficulty of conducting such studies since so little is known about the nature and relationships of educational inputs, processes, and outcomes.

In the few years since Levin made his remarks, the demand for information about the cost-effectiveness of instructional technology has grown. During this same period there have been a number of developments in related fields that should facilitate the conduct of the needed cost-effectiveness studies. First, there have been rapid advances in the theory and methodology of evaluation (Glass, 1976a, p.9): a discipline whose goals and activities are essentially the same as those of cost-effectiveness analysis. Second, a great deal of attention has been devoted to developing the methodology of cost analysis as applied to educational activities and programs (e.g. Coombs & Hallak, 1972; Doughty & Beilby, 1974; Haller, 1974; Witmer, 1972). Third and finally, there is a growing literature on the theory and methodology of cost-effectiveness analysis for education and other social program areas (e.g. Alkin, 1970; Levin, 1975; Pearson, 1972; Temkin, 1969).

With all of this activity, it would seem that the analyst's ability to conduct cost-effectiveness studies of instructional technology should be greatly improved. Unfortunately, this does not seem to be the case. In the most extensive literature search to date, Caffarella (1975) identified over 400 references on the cost-effectiveness of instructional technology. After reviewing over 300 of these references, Caffarella found only 32 that reported either empirical studies or included findings supported by quantitative data. He concluded that, "The current quantity and quality of research on the cost-effectiveness of instructional technology is low....it is evident that even though there has been a proliferation of writings in the cost-effectiveness of instructional technology there has been very little research on the subject (p. 15)."

The only way this situation is likely to change is through the conduct and accurate reporting of many empirical studies on instructional technology's cost-effectiveness. The existence of a literature containing such studies would be valuable whether or not the specific findings of any study were intended to be generalizable. This literature's value is in its potential ability to provide a series of case studies in the methods of cost-effectiveness analysis that could ultimately be used to improve those methods. For instance, given the descriptions of several cost-effectiveness studies on instructional technology, it should be possible to employ a technique like Stufflebeam's concept of meta-evaluation to assess the strengths and weaknesses of these studies in terms of the methods employed, and thereby provide information needed for decisions about the design of future studies.

It is on this basis that the following cost-effectiveness study is described. The emphasis is on reporting the methods rather than the study's actual findings. The study was originally conducted over a nine month period in 1975-

1976 and my comments are based upon a hundred page final report (Lent, 1976) which should soon be available through the Educational Resources Information Center (ERIC).

## A Cost-Effectiveness Evaluation Of Alternative Instructional Delivery Systems For Continuing Education Services

This study was commissioned to address certain concerns and interests of administrators from several colleges at Syracuse University: specifically, University College--the continuing education college, the School of Management, and to a lesser extent, the School of Engineering and the Center for Instructional Development. Administrators from each of these areas had their own view of the University's role in providing continuing education services.

University College was well aware of the growing demand for continuing education services. Enrollments in its programs had been increasing each year. They knew that in the future the University would be relying more heavily on tuition income from University College to help meet expenses elsewhere in the University. University College's administrators wondered if some system could be found to reach and enroll more adults throughout the central New York region. To be successful, however, any new program would have to make more efficient use of existing instructional resources (courses and faculty) and be supported by the faculty and departments who would offer the courses.

The School of Management, meanwhile, was heavily involved in current University College programs and they could see little room for expansion. Up to a third of its faculty's teaching load was already committed to continuing education courses. They were interested in a reduced commitment. The Assistant Dean thought he saw a solution to this situation. He had become familiar

with an interactive instructional television system in use at other universities and wanted University College to consider the use of such a system here. The system's attractiveness lay in its ability to have one faculty member simultaneously teach several sections of a course at different geographical locations. Such a television system would enable the School of Management to make more efficient use of its faculty's time. University College decided to fund this planning study to investigate the Assistant Dean's suggestion.

## Defining the Study

The initial charge was simply to evaluate the interactive instructional television system for use at Syracuse University. There would have been little point, however, in evaluating such a specific solution without knowing more about the initial problem and alternate solutions. Therefore, the first stage of this study was devoted to defining the problem and those variables that would determine the successfulness of any system for delivering continuing education courses through University College.

In order to better understand the problem, an informal evaluation was conducted to answer a variety of questions about the setting for any new delivery system. What were the goals or needs that a new delivery system[1] would be intended to satisfy? Who would judge the suitability of a new delivery system, and on what basis would that judgment be made? What changes would a new system bring about? What would be the problems facing its adoption?

To answer these questions, a series of interviews was held with people who had a variety of perspectives on continuing education, instructional

[1] The term "delivery system" as used in this study refers to that set of processes, equipment, activities, or facilities needed to provide a student with an educational experience (i.e., a course).

delivery systems, or University College. A report was prepared which summarized these interviews and the original interviewees were asked to react to this document.

This cycle of interviews coupled with some descriptive data about the University's operations provided enough information to define a goal for the performance of any delivery system that would be a successful solution to University College's situation. A first draft of this goal was circulated to a number of people for comments and the following statement was the result.

> The delivery system should promote the more efficient use of the University's existing instructional resources by expanding course enrollments with new students previously unable to attend on-campus offerings.

In the process of developing this goal, a number of requirements for delivery system performance were also defined. These requirements were based on the setting's characteristics and established the parameters for the design of a workable solution. Specifically, any delivery system for this situation should:

- Attract new students to the University (and not draw students away from existing continuing education programs).
- Increase the accessibility of Syracuse University courses for adults in the Central New York area.
- Provide unique educational services that are not in direct competition with those provided by existing area institutions.
- Maintain the University's standards of instructional quality.
- Provide an efficient, suitable learning environment for adult students.
- Be compatible with the goals, activities, and responsibilities of University faculty and academic departments.
- Promote more efficient utilization of existing faculty and instructional resources.
- Be politically and financially possible within the University's organizational structure.
- Require a relatively small initial investment of resources prior to any determination of actual performance.

The "ideal" delivery system would be one which met these requirements and achieved the stated goal in the most advantageous manner.

This information regarding the goal and performance requirements for a new delivery system for University College courses established the context within which the actual cost-effectiveness evaluation could be conducted. But cost-effectiveness implies comparison, and while the study was charged with evaluating one particular delivery system, interactive instructional television, it seemed that there were other delivery systems that might fit the goal and its performance requirements and provide the basis for a comparative judgment of the best kind of delivery system for University College. Thus, the decision was made to identify a range of delivery systems that would all meet the goal and its requirements, but in widely differing ways. A cost-effectiveness evaluation of a carefully chosen set of alternative systems would provide the University's administrators with the kind of information they needed for their decisions.[2]

The four alternative delivery systems that were ultimately selected for comparison are summarized on the next page. The four delivery systems are referred to as Live Lecture, Interactive Instructional Television, Mediated Self-Instruction, and Guided Independent Study. The Live Lecture system involves University faculty traveling to off-campus classrooms in surrounding communities to teach the same courses in the same way that they are normally taught on campus. This system was currently in use by University College in offering management and engineering courses at several locations in Upstate New York. The second system is Interactive Instructional Television and it involves the use of live, closed circuit, television presentations of University classes. The faculty member's on-campus course is televised to the off-campus classrooms and the off-campus students can participate in the on-campus class

[2]While the study was not originally conceived of as a cost-effectiveness analysis but only generally as evaluation, it became clear in defining the goal and its performance requirements that the nature of the decision situation called for cost-effectiveness information.

EXHIBIT

SUMMARY OF INSTRUCTIONAL DELIVERY SYSTEMS

LIVE LECTURE

The Live Lecture system is the accepted university teaching arrangement wherein the faculty member conducts live, in-person, class sessions with the students. Each semester a faculty member could teach one off-campus section of a course that he/she normally teaches on campus. One night a week the faculty member would travel to an off-campus classroom to meet with the students and teach the class. Off-campus students would receive the same instruction and perform the same learning and assessment activities as on-campus students. Course registration and administration procedures would be handled by University College in conjunction with the faculty member's academic department. The faculty member would be reimbursed for his traveling expenses in addition to being paid for teaching the course. Travel time to and from the off-campus classroom would average an hour or less in each direction.

INTERACTIVE INSTRUCTIONAL TELEVISION

This system is based on two-way audio and one-way video, closed circuit, television presentations of regular university class sessions. As the faculty member conducts an on-campus class, he/she is transmitted "live" to several off-campus classrooms equipped with television monitors. Students in the off-campus classrooms are able to interact with the instructor and participate in the on-campus class using special audio installations.

A faculty member using this system could teach his/her on-campus class in a normal fashion. The only changes would be the presence of television cameras in the classroom and the occasional interruption for a question from an off-campus student. Most classroom teaching techniques could be employed with little modification. Off-campus students would have their tests administered by a graduate assistant. For individual help, off-campus students would be expected to meet with the faculty member once during the semester and could call him/her by phone during specified office hours. Registration procedures, the administration of the off-campus classrooms, and the provision of books, supplies and televised lectures would be handled by University College (in conjunction with academic departments). The faculty member would have absolute control over the right to make any recordings or reproductions of the televised lectures.

MEDIATED SELF-INSTRUCTION

This system is based on the use of prerecorded video tapes of class sessions. The faculty member teaches his/her regular on-campus class each week. Television cameras record the class on video tape. Later that week, duplicate video tapes are made and sent to each off-campus class location. The off-campus students can view the tape locally anytime during the next week and are expected to keep up with and follow the same general schedule as the on-campus students. Faculty members would be available to off-campus students by phone during specific office hours each week. Off-campus students would also be expected to come to campus once or twice during the semester for personal counseling, testing, or instructional purposes. In short, off-campus students take the same course as on-campus students, but they do not participate in a "live" class, and hence, are more responsible for managing their own learning.

The video tape recording and distribution system (and other administrative details) would be handled by University College in conjunction with the academic departments. Special copyright agreements covering all uses of the tapes would be worked out with faculty. For their participation, faculty would receive appropriate compensation and the help of at least one graduate assistant.

GUIDED INDEPENDENT STUDY

The Guided Independent Study system is so named because it relies on students managing their own learning using specially designed materials which replicate the original, on-campus course without requiring live class sessions. The faculty member who normally teaches the on-campus course would design materials (e.g., exercises, programmed booklets, or special readings) to replace lectures and class sessions as the primary teaching strategy. Each off-campus student would receive a carefully structured instructional package including all materials and activities needed to complete the course at home. Off-campus students would usually come to campus twice each semester for assessment or special instructional activities. The faculty member would also be available to students by phone during specific hours each week.

This approach is based on a reorganization of the faculty member's time and instructional responsibilities. Rather than spending a number of hours each week in preparing and conducting each class session, the professor would do all of his/her preparation before the semester begins. Through University College (with the cooperation of the school or department) the faculty member would be provided with the financial, personnel, and material support to redesign his/her course for the off-campus students.

through the use of a special two-way audio installation. The Mediated Self-Instruction system removes the requirement for "live", interactive instruction, and has the off-campus student go to a local learning center where he/she can view video tapes of the on-campus class sessions and receive all the necessary materials for completing the same course of instruction as the on-campus students. Finally, the Guided Independent Study system differs from the other three systems by replacing lectures and class sessions as the primary teaching strategy and having the faculty develop special packages of instructional materials that enable the student to complete the course at home. Some of the characteristics of the four delivery systems are summarized in Table 1. With the exception of the Live Lecture system, all systems require off-campus students to travel to campus to meet with faculty once or twice a semester. Special provisions are also made for off-campus students to reach faculty by telephone when they need help. Graduate assistants would be added to help manage the off-campus instruction, administration of tests, and so on.

## Evaluation of the Delivery Systems

With the study's setting defined in terms of a goal and alternative means for its achievement, the next stage of the study involved the design and conduct of the cost-effectiveness evaluation.[3] Designing the study involved specifying the criteria, standards, and indicators with which delivery systems would be compared while deciding upon the procedures by which the multiple criteria would be combined to arrive at a final judgment.

The worth of this cost-effectiveness study was dependent upon the extent to which its findings aided the decision makers in choosing among the four

[3]The general conceptualization of this study followed Kazanowski's (1968) suggestions.

TABLE 1

SOME CHARACTERISTIC DIFFERENCES BETWEEN
THE DELIVERY SYSTEMS

| | LIVE LECTURE | INTERACTIVE INSTRUCTIONAL TELEVISION | MEDIATED SELF INSTRUCTION | GUIDED INDEPENDENT STUDY |
|---|---|---|---|---|
| Instructional Environment | | | | |
| • Class time and location fixed? | Yes | Yes | Partly | No |
| • Students able to interact with instructor during class? | Yes | Yes | No | No |
| • Students able to work at their own pace? | No | No | Maybe | Yes |
| Faculty Role and Responsibilities | | | | |
| • Off-campus sections added to on-campus courses with little impact upon teaching effort? | No | Yes | Yes(?) | Maybe |
| • Off-campus section requires change in instructional activities? | No | No | Maybe | Yes |
| System Costs | | | | |
| • Large capital investment required for system start-up? | No | Yes | Yes | No |
| • High recurring costs for each additional course or off-campus section? | Yes | No | No | No |

delivery systems and generally assisting with the planning deliberstions. This meant that the study had to address those criteria that were important to the decision makers. These criteria would then form the study's parameters just as they formed the framework for the decision makers' deliberations.

Criteria are the distinguishing characteristics or properties of something by which it may be judged. The number and nature of criteria relevant to a particular judgment is quite variable. While some judgments can be based on a single criterion, a cost-effectiveness judgment, by definition, requires a minimum of two criteria: one for input (or cost) and one for output (or effectiveness). In actual practice, however, it appears that a lot more than two criteria are involved in judging cost-effectiveness. A minimum of six criteria were needed in this study to portray the most important cost and outcome considerations from the viewpoints of the various decision makers.

The criteria selected for this study were derived from the same series of discussions conducted with faculty, administrators, and others to define the goal and performance requirements for delivery systems. The resulting six criteria were not seen as equally important or even relevant by all the decision makers, but taken together they covered most of the bases upon which any decision about a delivery system would be made. Each criterion is defined below in terms of the questions it poses for the evaluation of the delivery systems. Figure 1 illustrates how these six criteria form the framework for the cost-effectiveness comparison.

1) Instructional Effectiveness

Which delivery system(s) would provide the most effective teaching-learning environment for the adult learner? Specific points to be considered include:

Convenience. Which system(s) would provide the most convenient means for adult students to take courses?

Instructional adequacy. Which system(s) would provide the best learning environment for the majority of adult learners?

Desirability. Which system(s) would be likely to be attractive to the most students?

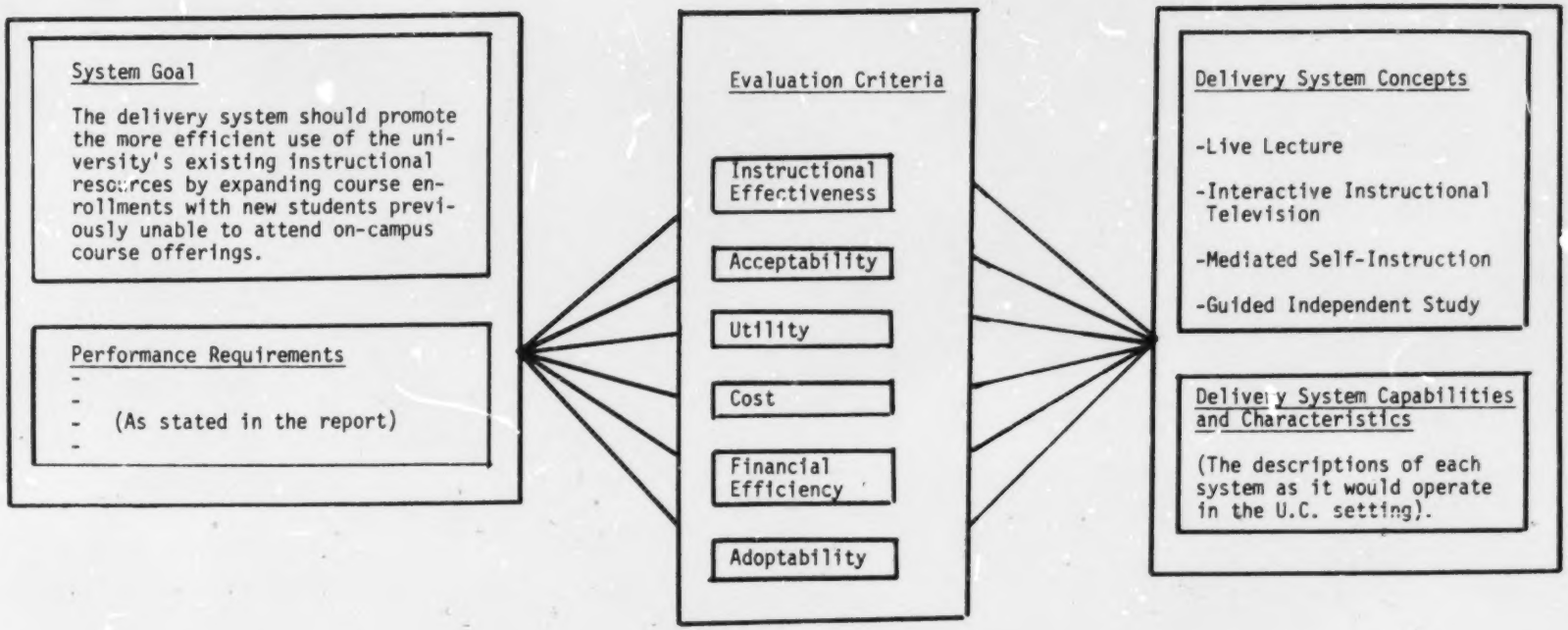
System Goal
The delivery system should promote the more efficient use of the university's existing instructional resources by expanding course enrollments with new students previously unable to attend on-campus course offerings.
Performance Requirements
-
-
- (As stated in the report)
-
Evaluation Criteria
Instructional Effectiveness
Acceptability
Utility
Cost
Financial Efficiency
Adoptability
Delivery System Concepts
-Live Lecture
-Interactive Instructional Television
-Mediated Self-Instruction
-Guided Independent Study
Delivery System Capabilities and Characteristics
(The descriptions of each system as it would operate in the U.C. setting).

Figure 1. Conceptual relationship between the goal statement, evaluation criteria, and the concepts and ascribed characteristics of the delivery systems. Adapted from Kazanowski (1968, p. 116).

2) Acceptability

Which delivery system(s) would be the most acceptable to the faculty who would have to work with them?

3) Utility

Which delivery system(s) would be the most functional from an administrative viewpoint? Specific points to be considered include:

Uniqueness. Would any system replicate or compete with existing programs run by this University or other area institutions?

Marketability. Which system(s) would be likely to attract a large enough clientele to be financially successful?

Exportability. Which system(s) would make it easiest to offer educational services in a changing variety of settings?

Dependability. Which system(s) would function consistently with a minimum of administrative problems?

4) Cost

Which system is the least expensive to develop and install, and which system is the least expensive to operate?

5) Financial Efficiency

Which delivery system(s) are the most financially efficient when considered over ten years at different enrollment levels?

6) Adoptability

Which system(s) would be the easiest innovation to adopt within the University College setting?

Comparing four delivery systems across multiple criteria is a complex task. Along with the selection of these six criteria, decisions had to be made regarding how the criteria would be used to arrive at judgments of cost-effectiveness. Specifically, decisions had to be made in two areas. First, would the performance of the delivery systems be treated as fixed across any of the criteria? And second, how would the criteria be combined and used to judge the relative cost-effectiveness of one system against another?

The issue of whether delivery system performance should be treated as fixed on some criteria is generally discussed in the cost-effectiveness literature as a choice between fixed cost and fixed effectiveness approaches to the analysis. These approaches involve structuring the evaluation such

that either the cost or the effectiveness side of the comparison is held constant for the alternatives (delivery systems) under consideration. While there are good reasons for the use of these approaches, neither approach seemed suitable given the kinds of planning deliberations this study was intended to support. Treating the systems as equally effective in the delivery of continuing education services would have ignored what many decision makers felt were potentially major differences in such areas as suitability for students, acceptability to faculty, and overall adoptability. On the other hand, comparing the systems on an equal cost basis would have limited the utility of the study's findings by masking the effects of differences in the kinds of costs incurred by the systems. Therefore it was decided to portray the situation as naturally as possible and not treat either side of the comparison as fixed. In order to conduct the study at all, however, assumptions had to be made about certain mediating variables (time, enrollment level, class size, and number of course offerings per semester) that would enable these variables to be controlled. For these variables it was decided to compare system performance at a number of fixed levels (i.e., number of years, enrollments of 100, 500, 1000 students, etc.).

Having considered how the criteria would be used in structuring the comparison, the second and related issue concerned how those criteria would ultimately be combined to judge the relative cost-effectiveness of one system against another. There are a number of ways in which this can be accomplished including mathematical models (dynamic simulations and cost-to-effectiveness ratios) and tabular displays. The tabular display approach was chosen since it summarizes evaluation findings without forcing specific conclusions. This was seen as a desirable feature given the study's intended role in

planning activities and the rather political nature of the study's context. Use of a mathematical model would have also required the decision makers to weight the relative importance of the criteria and for several reasons such a weighting activity seemed inappropriate at the time.

Conducting the study. To actually conduct the evaluation, a number of specific decisions had to be made regarding the methods to be employed in examining and comparing delivery system performance on each criterion. All of these decisions cannot be described here but a few key ones should be mentioned and some of the data gathering activities outlined.

This study, as all studies, was limited in its resources. When the study was ready for actual data gathering activities to begin, only half of its alloted time remained and few funds were available for major survey and data processing expenses. These conditions influenced decisions about the nature and extent to which the six criteria would be addressed.

Expert opinion, survey data, literature review, cost and logical analyses were some of the techniques employed in determining delivery system performance on the criteria. It was decided that original data would only be gathered to address the criteria of acceptability and cost. For acceptability, a survey was conducted of all faculty teaching through University College to gauge their attitudes towards characteristics of the delivery systems. To address the cost criterion, a variety of expert opinions, previous findings, and raw data were gathered from this and other institutions to estimate research and development, investment and production, and operation costs for each system. Delivery system performance on two other criteria, instructional effectiveness and adoptability, was analyzed using existing research in the areas of instructional technology, adult education, and educational innovation. The

criterion of financial efficiency required little additional data beyond that provided by the cost criterion. This left the criterion of utility for which there was little existing data and no time or resources for adequate investigation. This last criterion was only addressed through a logical analysis of how delivery system characteristics might determine their uniqueness, marketability, exportability, and dependability.

## Results

The findings of this cost-effectiveness evaluation were described and carefully documented on a criterion-by-criterion basis in a final report (Lent, 1976). A cost-effectiveness comparison matrix (Table 2) was prepared to summarize the findings across all four delivery systems. A brief review of some of the findings is provided below[4].

### Instructional Effectiveness

Under the criterion of instructional effectiveness the delivery systems were compared in terms of student achievement, attitudes, and suitability for the adult learner. This comparison involved a review of existing research and expert opinion. In each of the areas of comparison there were few clear findings of superiority for any of the systems. On student achievement, the media comparison studies indicated that both one-way television and independent study resulted in achievement comparable to that of students receiving face-to-face instruction. Two-way television appeared to be less effective than face-to-face or one-way television instruction, However, the practical utility of this finding could be questioned given the successful records of degree programs offered over interactive instructional television systems. When student attitudes towards the media were examined, it was found that students would like the Guided Independent Study or Mediated Self-Instruction systems for their convenience, and the other two systems for their provision of a traditional learning environment. Overall, one could conclude that the Guided Independent Study and Live Lecture systems would be most favorably received as respectively the most convenient and most traditional systems. Finally, the observations on the characteristics of adult learners suggest that Live Lecture provides the best environment for adults with Guided Independent Study in second place.

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[4]These findings are not necessarily generalizable to other situations and anyone interested in them should read the original report to gain a full appreciation for their validity and underlying assumptions.

TABLE 2

COST-EFFECTIVENESS COMPARISON MATRIX

| Criterion | Delivery Systems | | | |
|---|---|---|---|---|
| | Live Lecture | Interactive Instructional Television | Mediated Self-Instruction | Guided Independent Study |
| **Instructional Effectiveness** | | | | |
| Convenience | Least convenient. Highly structured, low curriculum flexibility. | Relatively inconvenient due to time-place structure. | Fairly convenient system for student use. | The most convenient system for students to use. |
| Instructional Adequacy | Highly appropriate for adult students. | Courses taught under these two systems should result in student achievement data similar to the other two systems; However, these systems are likely to be inferior in their ability to motivate, direct, and adapt to the needs of individual adult learners. | | Highly appropriate for adult students. |
| Desirability | Quite desirable to students who value the social interaction it provides. | Less desirable than Live Lecture. | Least desirable system to most students | Quite desirable to students who value its efficiency as a teaching-learning system. |
| Acceptability | Significantly more acceptable to faculty than any other arrangement. | Second choice of most faculty. | Least acceptable teaching arrangement to most faculty. | Second choice of many faculty. |
| **Utility** | | | | |
| Uniqueness and Marketability | Each system is uniquely suited to meeting specific requirements of different teaching-learning situations. Market and/or needs assessment data must be gathered to determine the nature of the potential clientele for courses offered under each (or any) of these systems. | | | |
| Exportability | Provides educational services which are fairly exportable and highly adaptable to new situations. | These systems provide services which are relatively harder to export and adapt to new and temporary settings. | | Provides the most exportable educational services. |
| Dependability | Easiest system to install and operate. | Each of these three systems has characteristic problems with its installation and/or operation. Guided Independent Study may have some slight advantage over the other two. | | |

TABLE 2 COST-EFFECTIVENESS COMPARISON MATRIX Continued

| Criterion | Live Lecture | Interactive Instructional Television | Mediated Self-Instruction | Guided Independent Study |
|---|---|---|---|---|
| **Costs** | | | | |
| Initial Cost to Install System (Up to first course offering) | $60,078 | $483,635 | $191,230 | $89,708 |
| Inremental Cost of Offering a Second Course | $4,633 | $4,510 | $5,135 | $22,447 |
| **Financial Efficiency** | | | | |
| Ten Year Operation Costs Under Model I | | | | |
| At 500 Students/Semester | | | | |
| Total | $3,634,074 | $3,549,033 | $2,806,220 | $2,711,323 |
| Unit Cost | $363 | $355 | $281 | $271 |
| At 1000 Students/Semester | | | | |
| Total | $6,626,522 | $5,115,591 | $4,267,973 | $4,731,883 |
| Unit Cost | $331 | $255 | $213 | $237 |
| Ten Year Operation Costs Under Model II | | | | |
| At 500 Students/Semester | | | | |
| Total | $2,475,062 | $2,536,090 | $1,903,033 | $1,488,717 |
| Unit Cost | $248 | $254 | $190 | $149 |
| At 1000 Students/Semester | | | | |
| Total | $4,286,820 | $3,106,480 | $2,478,524 | $2,310,848 |
| Unit Cost | $214 | $155 | $124 | $116 |
| Adoptability | As an innovation, this system is the most adoptable when considering the views of faculty and administrators | These three systems are much less adoptable overall. They differ somewhat in their potential adoptability: Under some circumstances they may equal Live Lecture in adoptability. | | |

Acceptability

After a review of previous studies primarily dealing with faculty attitudes towards televised instruction, a survey was designed to investigate the attitudes of Syracuse University faculty towards the four delivery systems. The intent was to determine which of the delivery systems would be most acceptable to the faculty who would have to work with them. In addition it was hoped that the survey might suggest those aspects of each system which shape the faculty's attitudes towards the system as a whole. The survey instrument gave faculty respondents a brief description of each delivery system and asked them to report the extent of their agreement/disagreement with each of 20 statements describing system characteristics. Surveys were sent to all full-time faculty currently teaching any courses through University College (N = 291). Returns were received from 201 faculty of which 169 were complete and usable for analysis (58% of total population).

This survey's findings agreed with earlier studies at other universities in showing that faculty have a strong preference for the traditional mode of classroom instruction. This preference is based on a number of factors, not the least of which is a very real concern for the quality of instruction offered through other kinds of educational arrangements (see Table 3). Statistical analysis showed that the responses to the Live Lecture system were significantly different from any of the other three systems. The responses to Interactive Instructional Television were also significantly different from the responses to Mediated Self-Instruction, but not to the responses for Guided Independent Study. Thus faculty are most favorable towards the use of Live Lecture with Interactive Instructional Television and Guided Independent Study rating a poor second and third.

Utility

Findings were generally inconclusive due to lack of information. See Table 2 for specifics.

Cost

This criterion was selected to address the issue of affordability. The focus was on the kind and size of expenditures required by each system. Estimates on the costs of the delivery systems were obtained from a variety of sources. The period for cost projections was set at 10 years. Two models (Model I, Model II) were developed to predict number of course offerings by enrollment level and class size under certain assumptions (see Table 4). The overall cost model used can be represented as:

$$S_a = \frac{(R+D)_t + (I+P)_t + OI_t + OA_t}{E_t}$$

where $S_a$ = Average cost per student, per course

$(R+D)_t$ = Total research and development costs.

$(I+P)_t$ = Total investment and production costs.

$OI_t$ = Total operating costs for instruction as determined by

$$OI_t = (OI_a)(C)$$

where $OI_a$ = Average operating costs per course,

and C = Number of courses being offered.

TABLE 3

FACULTY REACTIONS TO FOUR SYSTEMS ON SURVEY ITEMS

After reading a brief description of a given delivery system, faculty were asked to indicate the extent of their agreement with each of the following statements as they applied to that system. This process was repeated for each of the four systems. They responded on a five point scale for each item ranging from 1 for strong agreement to 5 for strong disagreement with a specific statement. Note that some statements express negative opinions while others express positive opinions towards a system. The scale is summarized as:

| SA | A | N | D | SD |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

| Mean Response to Each System | | | | Statement |
|---|---|---|---|---|
| Live Lecture | Interactive Instruc. TV | Mediated Self-Ins. | Guided Inde. Study | |
| 1.70 | 2.97 | 3.38 | 2.95 | The use of this system would help off-campus students maintain their motivation to complete the course. |
| 3.86 | 2.54 | 2.43 | 2.70 | Most off-campus students who took courses offered through this system would feel that they are receiving a "second-hand" education in comparison to that of on-campus students. |
| 3.95 | 3.00 | 2.81 | 2.70 | This system is <u>not</u> suitable for teaching most courses in my subject matter. |
| 2.97 | 2.92 | 2.92 | 2.89 | This system could improve the quality of many courses by causing professors to devote more attention to their teaching. |
| 3.59 | 2.19 | 2.19 | 2.41 | Many faculty would feel uncomfortable working in this kind of instructional environment. |
| 3.86 | 3.05 | 2.70 | 2.84 | The use of this system would contribute to a trend towards the lowering of academic standards and would generally have an adverse effect on the quality of the University's curriculum. |
| 2.11 | 3.32 | 3.59 | 3.43 | Most faculty would support the use of this system with continuing education programs. |
| 2.35 | 3.05 | 3.49 | 3.59 | This system would enable me to teach more students with little, if any, loss in the quality of instruction. |
| 3.62 | 3.19 | 2.70 | 2.49 | I feel that teaching one of my courses under this system would require me to spend too much extra time and effort to be worth it. |
| 3.84 | 2.62 | 2.24 | 2.43 | This system would never work well because it limits the instructor's ability to adapt the instruction to the needs of the students. |
| 2.24 | 3.49 | 3.78 | 3.62 | This system would provide the kind of quality education people expect from a private university. |
| 2.14 | 3.08 | 3.38 | 3.35 | This system would be appropriate for most university courses and subject areas. |
| 3.14 | 2.95 | 2.81 | 2.86 | The use of this system would create political problems for some academic departments. |
| 2.46 | 2.43 | 2.57 | 2.97 | Overall, this system should help the University to make more efficient use of its faculty and instructional resources. |
| 1.70 | 2.78 | 2.89 | 2.84 | This system would attract new adult students to S.U. courses. |
| 3.27 | 3.24 | 3.03 | 2.57 | I feel that using this system would take too much of my time away from research and other activities necessary for promotion. |
| 2.54 | 3.73 | 3.95 | 3.57 | Most off-campus students would feel that this system provides enough opportunities for interaction with faculty. |
| 2.24 | 3.19 | 3.46 | 3.32 | I would definately be willing to teach one of my courses using this system. |
| 2.08 | 2.68 | 2.86 | 2.72 | Testing and grading procedures could be handled efficiently under this system. |
| 3.86 | 2.81 | 2.43 | 2.51 | This system promotes an undesirable trend towards the standardization and commercialization of higher education. |

Table 4

DETERMINATION OF NUMBER OF COURSE

OFFERINGS BY ENROLLMENT LEVEL

Average Class Size Predictions

| Delivery System | Model I | Model II |
|---|---|---|
| Live Lecture | 18 | 30 |
| Interactive Instructional Television | 36 | 150 |
| Mediated Self-Instruction | 36 | 150 |
| Guided Independent Study | 36 | 150 |

Model I predictions represent the average minimum per-course enrollments for each system. The figure of 18 students under Live Lecture was chosen because it is the class size presently needed to run courses at the existing, off-campus graduate centers. The figure of 36 students for each course offered under the other systems was arbitrarily chosen to be twice that of Live Lecture since it represents enrollments across five classrooms* or for a group of at-home students.

Model II predictions represent the average maximum per-course enrollments for each system. The figure of 30 students under Live Lecture was chosen because it is the standard maximum figure for a "small" lecture-discussion class. The 150 student per course figure for Interactive Instructional Television and Mediated Self-Instruction systems represents 30 students per class location. The guided Independent Study system uses the same prediction to be comparable.

Number of Course Offerings by Enrollment Level**

| Predicted Semester Enrollment | Number of Course Offerings | | | |
|---|---|---|---|---|
| | Model I | | Model II | |
| | Live Lecture | All Others | Live Lecture | All Others |
| 100 | 5.5 | 2.8 | 3.3 | 1 |
| 500 | 27.7 | 13.9 | 16.7 | 3.3 |
| 1000 | 55.5 | 27.8 | 33.3 | 6.7 |
| 1500 | 83.3 | 41.7 | 50 | 10 |
| 2000 | 111 | 55.6 | 66.7 | 13.3 |
| 2500 | 138.8 | 69.4 | 83.3 | 16.7 |

* There are five classroom locations; Oswego, Fulton, Oneida, Watertown, and on-campus.

** All courses assumed to be standard three credit courses.

$OA_t$ = Total operating costs for administration as determined by $OA_t = (OA_a)(Y)$

where $OA_a$ = Average administrative costs per year and

Y = Number of years.

$E_t$ = Total enrollment for the period of the cost comparisons.

Tables 5, 6, 7, and 8 display the basic cost estimates for each delivery system. The relative expensiveness of the systems was examined by comparing them on the size of their initial implementation costs and subsequent long-term expenditures for operation (Tables 9 and 10).

Financial Efficiency

The cost model and system cost data obtained above provided the basis for predicting system costs over time. Table 11 presents both the total costs and unit costs for each system, at different enrollment levels, and under either Model I or Model II predictions. (Model I predictions produce estimates for conditions where there are a large number of courses being taught with minimum average per-course enrollments. Model II predictions give costs for maximum average per-course enrollments and fewer courses being offered. See Table 4.) Figures 2 and 3 graph the unit cost data under Model I and Model II conditions. Three conclusions were drawn from this data. First, there is a major reduction in unit costs for all systems when the average enrollment level changes from 100 to 500 students per semester. Second, there is relatively little difference in the unit costs between Model I and Model II predictions. This implies that economy of scale has little influence beyond a certain minimum per-course enrollment level (e.g. 18). Third, for enrollments in excess of 500 students per semester, the Live Lecture system is decidedly the most expensive system over time. The least expensive system varies somewhat as enrollments increase, but there is very little difference in the cost projections for the other three systems.

Adoptability

The last criterion for judging the four delivery systems concerned the relative ease of their adoption into the University setting. Based primarily on Roger's and Shoemaker's (1971) research and definition of the perceived attributes of an innovation which affect its adoption, the Live Lecture system was judged as the most easily adopted approach. There were indications, however, that other systems could become more adoptable through careful modifications and the addition of incentives.

The study's report concluded with a number of observations regarding the implications of these kinds of delivery systems for University College, and the ways in which this study could be used to support planning activities in this area. Some specific "next steps" were also described. As of this writing, however, there are few signs that the study or its final report have had any impact. At least in part this may be due to changing political pressures in the University College setting that have temporarily lessened the attention devoted to this area.



(Text resumes on page 37).

TABLE 5

COSTS FOR LIVE LECTURE SYSTEM

| | | | |
|---|---|---|---|
| **Research and Development Costs**[1] | | | |
| Personnel | | | |
| Program administrator (6 mos. at $20,000/year) | | $10,000 | |
| Secretary (6 mos. at $6,000/year) | | $ 3,000 | |
| Fringe Benefits (at 24.5% of above) | | $ 3,185 | |
| | Total Personnel Costs: | | $16,185 |
| Office Expenses ($1000 per office/year) | | | $ 1,000 |
| Preliminary Study (Market Analysis, etc.) | | | $20,000 |
| | Total Research and Development Costs: | | $37,185 |
| **Investment and Production Costs** | | | |
| NONE | | | |
| **Operating Costs - Instruction** | | | |
| Personnel[2] | | | |
| Faculty course instructor (12.5% base salary of $20,560) | | $ 2,570 | |
| Fringe Benefits (24.5% of above) | | $ 630 | |
| Dislocation allowance | | $ 1,000 | |
| | Total Personnel Costs: | | $ 4,200 |
| Travel (One round-trip of 150 miles per week at $.15/mile) | | | $ 113 |
| Instruction Supplies[3] | | | $ 150 |
| Facilities - Classroom Rental[4] | | | $ 20 |
| Telephone Service (under Model I)[5] | | | $ 75 |
| | Total Instructional Costs Per Course: | | $ 4,633 |
| **Operating Costs - Administration** | | | |
| Personnel[2] | | | |
| Program administrator (at $15,000/year) | | $15,000 | |
| Secretary (at $6,000/year) | | $ 6,000 | |
| Fringe Benefits (at 24.5% of above) | | $ 5,145 | |
| Four half-time area representatives (at $3,000 each) | | $12,000 | |
| | Total Personnel Costs: | | $38,145 |
| Facilities | | | |
| Administrative Office Space (Existing U.C. facilities) | | $ ---- | |
| Local area office rental ($100 a month for each of four offices) | | $ 4,800 | |
| Office expenses (Two full-time, and four part-time offices) | | $ 4,000 | |
| | Total Facilities Costs: | | $ 8,800 |
| Advertising and Brochures[6] | | | $ 7,836 |
| | Total Administrative Costs Per Year: | | $54,781 |

Explanatory notes on next page.

NOTES TO TABLE 5

[1]Research and Development Costs cover only those costs attributable to the implementation of this specific system. Money allocated for a Preliminary Study under this and the other systems recognizes the need for specific kinds of market research or needs assessment data to guide the development of any new instructional system. The estimate of $20,000 is based on Genesys System's prediction for its own preliminary study. This figure may be off by as much as 50% in either direction depending on the amount of research and other activities preceding the decision to implement a particular system.

The program administrator position is funded at a higher level here to allow for the use of consultants or to reflect the demand for additional high-level administrative support during this formative period.

[2]All recurring salary costs are assumed to rise by 5% each year over the ten year planning period. The figures given here represent the salary costs for the first year (based on 1976 data). In Appendix B is a table which outlines the projected salary and fringe benefit increases. The faculty base salary of $20,560 is an average salary for regular university faculty currently teaching at University College. The derivation of this figure is also explained in the appendix.

[3]Estimates for several items such as instructional supplies or office expenses represent standard "best guesses" for University College operations.

[4]The classroom rental figure of $20 per course is probably low. However, it is assumed that the university will not have any permanent facilities, but instead will contract for the temporary use of rooms in a local school, church, library, or business. It is also assumed that some space will be donated by area businesses to facilitate the enrollment of their employees in the courses. The estimated rent for local offices is based on some of those same assumptions.

[5]Telephone service cost estimates are based on a daytime rate for a collect, operator assisted call from approximately 75 miles away. If the average call is ten minutes long, the cost is $4.18 per call. Assuming one call per student and a Model I enrollment level of 18, the phone bill is $75 for one course. Under Model II enrollment levels the cost is $150 per course. These costs could be lowered by 30% if the calls were made at night (or doubled if the calls were person-to-person). According to the university's telecommunications office, an "800" telephone line is not feasible.

[6]Cost estimates for brochures assume mailings to potential university students in four area communities (e.g. Watertown, Fulton, Oswego, Oneida). Brochures are four-paged newsprint. Other advertising costs cover radio and newspaper spots in each community. These expenses are assumed to be similar for all four instructional systems.

Note: For more detailed explanations, and for the information contained in the appendices referred to here, see the original report.

TABLE 6

COSTS FOR INTERACTIVE INSTRUCTIONAL TELEVISION SYSTEM

| | | | |
|---|---|---|---|
| **Research and Development Costs**[1] | | | |
| Personnel | | | |
| Program administrator (6 mos. at $20,000/year) | $10,000 | | |
| Secretary (6 mos. at $6,000/year) | $ 3,000 | | |
| Fringe Benefits (at 24.5% of above) | $ 3,185 | | |
| | Total Personnel Costs: | $ 16,185 | |
| Office Expenses ($1,000 per office/year) | | $ 1,000 | |
| Preliminary Study (Market and Risk Analysis, etc.) | | $ 20,000 | |
| | Total Research and Development Costs: | | $ 37,185 |
| **Investment and Production Costs**[2] | | | |
| Capital investment for a two channel production/transmission Facility with radio frequency talk-back. (Estimate includes engineering, equipment, and installation) | | $360,000 | |
| Capital investment for four instructional facilities with two classrooms each, (Equipment and installation) | | $ 40,000 | |
| | Total Investment: | | $400,000 |
| **Operating Costs - Instruction** | | | |
| Personnel[3] | | | |
| Faculty course instructor (12.5% base salary of $20,560) | $ 2,570 | | |
| Fringe Benefits (24.5% of above) | $ 630 | | |
| Studio operators ($3.00/hour x 4 hours/week x 15 weeks) | $ 180 | | |
| Graduate assistant (For Model I: 1/2 time/course/semester) | $ 800 | | |
| | Total Personnel Costs: | $ 4,180 | |
| Travel (at $.15/mile)[4] | | $ 180 | |
| Instructional Supplies | | $ 150 | |
| Telephone Service (for Model I)[5] | | $ 301 | |
| | Total Instructional Costs Per Course: | | $ 4,510 |
| **Operating Costs - Administration** | | | |
| Personnel[3] | | | |
| Program administrator | $15,000 | | |
| Chief engineer | $12,000 | | |
| Technical Assistant | $ 8,000 | | |
| Secretary | $ 6,000 | | |
| Area representatives (Four 1/2 time employees at $6,000/year) | $12,000 | | |
| Fringe Benefits (at 24.5% of above) | $12,985 | | |
| | Total Personnel Costs: | $ 65,985 | |
| Advertising/Brochures | | $ 7,836 | |
| Administration/Production Office Space | | $ ---- | |
| Local Classroom/Office Rental[6] | | $ 6,000 | |
| Office Expenses (Four Full-time, four part-time) | | $ 6,000 | |
| Equipment Repair/ Replacement (10% of Total Investment) | | $ 40,000 | |
| | Total Administrative Costs Per Year: | | $125,821 |

Explanatory notes on next page.

NOTES TO TABLE 6

[1]The comments on the research and development costs of the Live Lecture System also apply here, except that the $20,000 estimate for the Preliminary Study is much more accurate. In this system, the Preliminary Study covers more than market analysis - it also includes the attempt to establish agreements with local industries for the support of the system.

[2]These capital investment estimates are based on the actual costs for the recent installation of a two channel interactive instructional television system at the Illinois Institute of Technology. These estimates are also very similar to the costs for Genesys installations at other campuses. The most debatable expense within this estimate is that for the radio-frequency talk-back capability. The costs for this component amount to about 15% of the total capital investment and some schools have avoided this expense by working out a monthly line-rental agreement with the telphone company and substituting a telephone talk-back system. The radio-frequency system has been chosen here since it is less expensive in the long run.

The cost estimates were obtained through conversations with Albert Morris of Genesys Systems and represent 1976 expenditures. A detailed explanation of these costs can be found in Morris, et al, (1974). The costs for the production facility include all engineering and installation costs, equipment for and remodeling of two "studio" classrooms, control rooms, transmission facilities, duplication equipment, and spare parts. The costs for the remote instructional facilities include television sets, audio installations, and reception equipment for two classrooms at each of four different geographic locations.

Opportunity costs of 8% interest a year on a ten year investment will also be included in determining the total cost of this system. The opportunity cost for a capital investment of $400,000 when depreciated over ten years is $176,000. See the table on opportunity costs in the appendix for further information.

[3]Salary costs for all personnel (except hourly help and graduate assistants) are predicted to rise by 5% each year. See the table in the appendix for the predicted salary increases.

The estimate for the graduate assistant is based on Model I enrollments of 36 students per course. Under Model II (with 150 students per course) there would be two graduate assistants assigned to each course, and the cost would be $2,600 per semester.

[4]Travel is computed by assuming two round trips of 150 miles, per remote classroom location, per course.

[5]Telephone service costs (for private student-faculty consultations) are based on the same assumptions used within the Live Lecture System. The estimate is based on an average of two calls per student. For Model II enrollment the cost is $1,254.

[6]Space rental is assumed to be $1,500 per locations, per year, or $6,000 total each year for all locations. This estimate is quite low, but is based on the assumption that at least 1/3-1/2 of the space will be donated by cooperating industries or other local institutions.

TABLE 7

COSTS FOR MEDIATED SELF-INSTRUCTION SYSTEM

| | | | |
|---|---|---|---|
| **Research and Development Costs**[1] | | | |
| Personnel | | | |
| Program administrator (6 mos. at $20,000/year) | | $10,000 | |
| Secretary (6 mos. at $6,000/year) | | $ 3,000 | |
| Fringe Benefits (at 24.5% of above) | | $ 3,185 | |
| | Total Personnel Costs: | | $16,185 |
| Office Expenses | | | $ 1,000 |
| Preliminary Study | | | $20,000 |
| | Total Research and Development Costs: | | $37,185 |
| **Investment and Production Costs**[2] | | | |
| Production Facilities and Equipment | | | |
| Equipment for two studio classrooms and control rooms | | $35,955 | |
| Equipment for master control (duplicating equipment) | | $19,280 | |
| Spare parts | | $ 5,000 | |
| Room modifications for studio classrooms | | $ 2,000 | |
| | Production Facilities Total: | | $62,235 |
| Facilities and Equipment for Four Media Centers | | | |
| Facility renovation | | $ 8,000 | |
| Audio-Visual Equipment | | $34,250 | |
| | Media Center Facilities Total: | | $42,250 |
| Video Tape Investment Costs (for Model I or II) - $ varies with projected enrollment[3] | | | |
| | Total I and P Costs (Excluding Video Tape): | | $104,485 |
| **Operating Costs-Instruction** | | | |
| Personnel[4] | | | |
| Faculty course instructor (12.5% base salary of $20,560) | | $ 2,570 | |
| Fringe Benefits | | $ 630 | |
| Studio operators ($3.00/hour x 4 hours/week x 15 weeks) | | $ 180 | |
| Graduate assistant (for Model I: 1/2 time/course/semester) | | $ 800 | |
| | Total Personnel Costs: | | $ 4,180 |
| Miscellaneous[5] | | | |
| Materials duplication costs (for Model I with 100 pages/$.10 ea.) | | $ 360 | |
| Mailing (for Model I assuming $4.00/student) | | $ 144 | |
| Telephone service (for Model I) | | $ 451 | |
| | Total: | | $ 955 |
| | Total Instructional Costs Per Course: | | $ 5,135 |
| **Operating Costs-Administration** | | | |
| Personnel[4] | | | |
| Program administrator | | $15,000 | |
| Instructional developer/evaluator[6] | | $15,000 | |
| Chief engineer | | $12,000 | |
| Secretary | | $ 6,000 | |
| Messenger | | $ 6,000 | |
| Media center personnel (four 1/2 time employees at $6,000/year) | | $12,000 | |
| Technical assistant | | $ 8,000 | |
| Fringe Benefits (at 24.5% of above) | | $18,130 | |
| | Total Personnel Costs: | | $92,130 |
| Advertising/Brochures | | | $ 7,836 |
| Miscellaneous[7] | | | |
| Administrative office space (existing U.C. facilities) | | $ ---- | |
| Media center facility rental | | $ 6,000 | |
| Office expenses (four full-time, and four part-time offices) | | $ 6,000 | |
| Travel (messenger service for delivering materials) | | $ 6,000 | |
| Equipment repair/replacement (10% of total I and P costs) | | $10,448 | |
| | Total: | | $28,448 |
| | Total Administrative Costs Per Year: | | $128,414 |

Explanatory notes on next page.

NOTES TO TABLE 7

[1]Costs for research and development activities are based on the same assumption here as they were in the Live Lecture System.

[2]The estimated costs for Production Facilities and Equipment assume the establishment of a classroom production facility similar to that of the Interactive Instructional Television System (except there are no talk-back on live transmission capabilities). Facility renovation costs for the four media centers are quite low since they assume that local schools, libraries, or businesses will donate some resources if the media center is located in their institution. Detailed lists of the estimated costs of both the production and media center facilities are provided in the appendix.

The total capital investment of $104485 is depreciated over ten years with an opportunity cost of 8% per year totaling $44000. See opportunity cost table in appendix.

[3]Video tape costs are for hour long 3/4" cassettes. Total costs of video tape is computed with the following formula:

Total = $27.00 a tape x _ courses x 3 hours each week
x 5 copies each hour x 4 weeks.

Formula assumes a four week supply of tape before erasure and reuse. Number of courses is determined under Model I or Model II predictions. All tape is replaced after five years.

[4]Salaries for all instructional and administrative personnel (except the hourly help and the graduate assistant) are assumed to increase at the rate of 5% each year. Refer to the appendix for the specific dollar amounts of these increases.

[5]The costs for the graduate assistant and miscellaneous categories are for cost predictions under Model I which assumes 36 students per course. Under Model II, the materials and mailing costs would obviously increase (to accomodate 150 students per course) and these would be two graduate assistants assigned to each course.

[6]The developer/evaluator position has been added since it is assumed that some faculty may have to revise parts of their courses to offer them through this system.

[7]Rental costs for the media centers are assumed to be $1500/per location each year, or $6,000 total. This estimate is quite low, but is based on the assumption that at least 1/3 - 1/2 of the facilities costs will be donated by cooperating industries on local institutions.

Travel costs appear here under the administration category since they represent a continuing expense for maintaining the media centers no matter how many courses are being offered.

Costs for telephone services are based on the same assumptions here as in the Live Lecture System, except that it is assumed that there is an average of three calls per student (due to the lack of direct student-faculty contact). For Model II the cost is $1,881.

TABLE 8

COSTS FOR GUIDED INDEPENDENT STUDY SYSTEM

| | | | |
|---|---|---|---|
| **Research and Development Costs** | | | |
| Program Planning (Non-recurring costs)[1] | | | |
| Personnel | | | |
| Program administrator (6 mos. at $20,000/year) | $10,000 | | |
| Secretary (6 mos. at $6,000/year) | $ 3,000 | | |
| Instructional developer (6 mos. at $15,000/year) | $ 7,500 | | |
| Fringe Benefits (at 24.5% of above) | $ 5,023 | | |
| Total Personnel Costs: | | $25,523 | |
| Office Expenses | | $ 1,500 | |
| Preliminary Study (Needs assessment, curriculum planning, etc.) | | $20,000 | |
| Total Non-Recurring R&D Costs: | | | $47,023 |
| Course Development (Recurring costs for each project)[2] | | | |
| Personnel | | | |
| Faculty course instructor (two months at $20,560/year) | $ 3,427 | | |
| Instructional developer (two months at $15,000/year) | $ 2,500 | | |
| Evaluator (two months at $15,000/year) | $ 2,500 | | |
| Secretary (two months at $6,000/year) | $ 1,000 | | |
| Fringe Benefits (at 24,5% of above) | $ 2,310 | | |
| Total Personnel Costs: | | $11,737 | |
| Office Expenses | | $ 700 | |
| Miscellaneous | | | |
| Printing/duplication (20,000 pages at $.10/page) | $ 2,000 | | |
| Media production costs (slides, tapes, illustrations) | $ 1,000 | | |
| Other costs (e.g. field testing; 10% of above costs) | $ 1,544 | | |
| Total: | | $ 4,544 | |
| **Total Recurring R&D Costs for Course Development:** | | | $16,981 |
| **Investment And Production Costs** | | | |
| NONE | | | |
| **Operating Costs - Instruction** | | | |
| Personnel[3] | | | |
| Faculty course instructor (12.5% base salary of $20,560) | $ 2,570 | | |
| Fringe Benefits (at 24,5% of above) | $ 630 | | |
| Graduate Assistant (For Model I: 1/2 time/course/semester) | $ 800 | | |
| Total Personnel Costs: | | $ 4,000 | |
| Materials Duplication Costs (for Model I with 200 pages/$.10 ea.) | | $ 720 | |
| Mailing (For Model I at $4.00/student) | | $ 144 | |
| Telephone Service (For Model I and four calls/student) | | $ 602 | |
| Total Instructional Costs Per Course[4]: | | | $ 5,466 |
| **Operating Costs - Administration** | | | |
| Personnel[3] | | | |
| Program administrator | $15,000 | | |
| Instructional developer[5] | $15,000 | | |
| Secretary | $ 6,000 | | |
| Fringe Benefits | $ 8,820 | | |
| Total Personnel Costs: | | $44,820 | |
| Advertising/Brochures | | $ 7,836 | |
| Miscellaneous | | | |
| Administrative office space | $ ---- | | |
| Office expenses (five offices) | $ 5,000 | | |
| Travel (for counseling, promotional purposes)[6] | $ 3,000 | | |
| Total: | | $ 8,000 | |
| Total Administrative Costs Per Year: | | | $60,116 |

Explanatory notes on next page.

NOTES TO TABLE 8

[1]Costs for the Program Planning segment of these R&D costs are based on the same assumptions as they were in the Live Lecture System. However, an instructional development position has been added to the planning stage.

[2]The other instructional systems have not included costs for course development since the other systems enable the faculty member to teach the same course in basically the same way as he/she always had. Here it is assumed that each course will be designed (or redesigned) from scratch every five years in order that the course may be offered through this system. Over a ten year period, these costs would occur twice for each course.

These development costs may vary widely from course to course and these estimates represent a rough average. These costs do not represent the level of development effort usually involved in the Center for Instructional Development's course projects. It is assumed that the faculty member will be able to prepare his course for delivery over this system without going into full-scale reconsideration of his subject matter and objectives. The costing of instructional improvement efforts is not germane to nature of this study.

[3]Salaries for all instructional and administrative personnel (except the graduate assistant) are assumed to increase at the rate of 5% each year.

For Model II (150 students/course) the following cost estimates apply.

| | |
|---|---|
| Materials Duplication Costs | $3,000 |
| Mailing | $ 600 |
| Telephone Service | $2,508 |

[4]The telephone service is computed at the same rate as it was for the Live Lecture System, except that it is assumed that there is an average of four calls per student (due to the lack of direct student-faculty contact).

For Model II, the graduate assistant costs are $2,600/course.

[5]This is an administrative position seperate from the development position listed under course development costs.

[6]Administrative travel is figured at the monthly rate of two, 500 mile trips at $.15/mile and four days at $25 per diem. This cost may be unnecessary, but it is based on the assumption that a university representative will have to travel to various communities to meet with current and potential future students to keep the program running.

Table 9

INITIAL COSTS FOR EACH SYSTEM

THROUGH FIRST COURSE OFFERING*

| Cost Categories | Delivery Systems | | | |
|---|---|---|---|---|
| | Live Lecture | Interactive Instructional Television | Mediated Self-Instruction | Guided Independent Study |
| Research & Development | $37,185 | $37,185 | $37,185 | $47,023 |
| Course Development | ___ | ___ | ___ | $16,981 |
| Investment & Production | ___ | $400,000 | $106,105 | ___ |
| Operating Costs - Instruction | $4,633 | $4,510 | $5,135 | $5,466 |
| Operating Costs - Administration (four months) | $18,260 | $41,940 | $42,805 | $20,038 |
| Total Cost | $60,078 | $483,635 | $191,230 | $89,708 |

* These costs were determined from Tables 4,5,6,&7. Opportunity costs have not been added to the Investment and Production expenses.

Table 10

RECURRING AND NON-RECURRING COMPONENTS OF

TOTAL SYSTEM COSTS: PERCENT OF TOTAL COSTS PER CATEGORY

| Cost Categories | Initial Costs Through First Course Offering* | | | | Total Costs for Ten Year Operation With One Thousand Students/Semester** | | | |
|---|---|---|---|---|---|---|---|---|
| | Live Lecture | Interactive Instructional Television | Mediated Self-Instruction | Guided Independent Study | Live Lecture | Interactive Instructional Television | Mediated Self-Instruction | Guided Independent Study |
| Research and Development | 62% | 7% | 19% | 52% | 1% | 1% | 1% | 1% |
| Course Development | ---- | ---- | ---- | 19% | ---- | ---- | ---- | 20% |
| Investment & Production | ---- | 83% | 56% | ---- | ---- | 11% | 5% | ---- |
| Operating Costs - Instruction | 8% | 1% | 3% | 6% | 90% | 61% | 67% | 65% |
| Operating Costs - Administration | 30% | 9% | 22% | 23% | 9% | 27% | 27% | 14% |
| Total Non-recurring Costs | 62% | 90% | 75% | 52% | 1% | 12% | 6% | 1% |
| Total Recurring Costs | 38% | 10% | 25% | 48% | 99% | 88% | 94% | 99% |

* Based on cost data from Table 8

** Based on cost data from Table 11 under Model I predictions for average class size.

(Model I and II predictions are used to predict recurring costs using estimates of minimum and maximum average course enrollments to predict the number of courses offered at different enrollment levels. Model I predictions assume a minmum enrollment of 18 students/course for Live Lecture and 36 students/ course for the other three systems. Model II predictions assume a maximum average enrollment of 30 students/course for Live Lecture and 150 students/course for all others. See Table 3, page 44 for further information.)

Table 11

UNIT AND TOTAL COSTS FOR EACH SYSTEM OVER TEN YEARS

| Enrollment Per Semester | Prediction Model | Live Lecture | | Interactive Instructional Television | | Mediated Self-Instruction | | Guided Independent Study | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | Unit Cost | Total | Unit Cost | Total | Unit Cost | Total | Unit Cost |
| 100 | I | $1,244,422 | $622 | $2,298,041 | $1149 | $1,638,922 | $819 | $1,097,783 | $549 |
| | II | $1,012,559 | $506 | $2,150,237 | $1075 | $1,513,731 | $757 | $932,567 | $466 |
| 500 | I | $3,634,074 | $363 | $3,549,033 | $355 | $2,806,220 | $281 | $2,711,323 | $271 |
| | II | $2,475,062 | $248 | $2,536,090 | $254 | $1,903,033 | $190 | $1,488,717 | $149 |
| 1000 | I | $6,626,522 | $331 | $5,115,591 | $255 | $4,267,973 | $213 | $4,731,883 | $237 |
| | II | $4,286,820 | $214 | $3,106,480 | $155 | $2,478,524 | $124 | $2,310,848 | $116 |
| 1500 | I | $9,618,970 | $321 | $6,682,148 | $223 | $5,729,724 | $191 | $6,752,441 | $225 |
| | II | $6,109,491 | $204 | $3,660,095 | $122 | $3,027,089 | $101 | $3,108,803 | $104 |
| 2000 | I | $12,600,653 | $315 | $8,248,706 | $206 | $7,191,476 | $180 | $8,773,001 | $219 |
| | II | $7,932,162 | $198 | $4,213,710 | $105 | $3,582,354 | $90 | $3,906,757 | $98 |
| 2500 | I | $15,593,100 | $312 | $9,803,994 | $196 | $8,642,712 | $172 | $10,779,025 | $215 |
| | II | $9,743,919 | $195 | $4,784,100 | $96 | $4,154,444 | $83 | $4,728,889 | $95 |

Figure 2

MODEL I UNIT COST COMPARISON

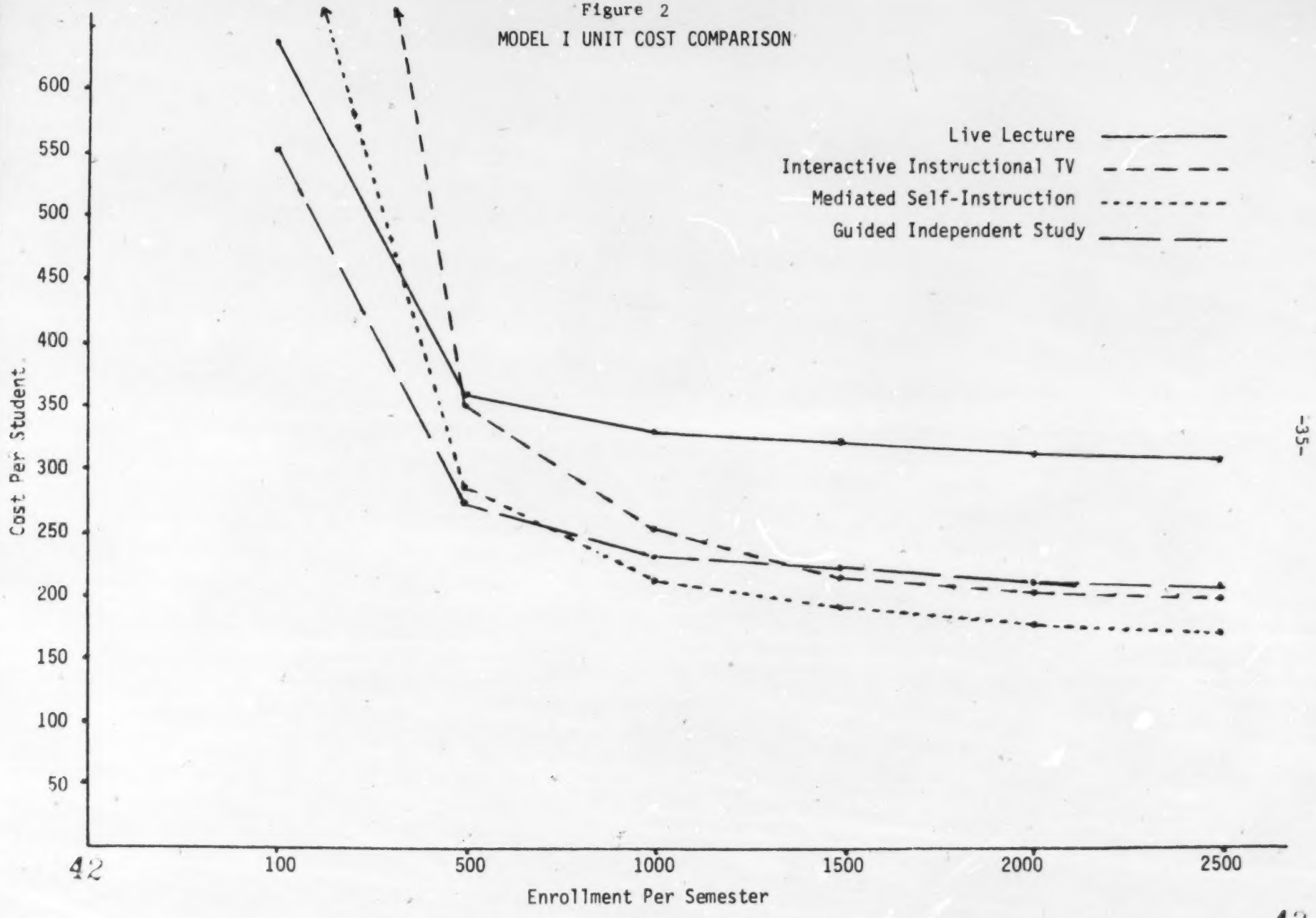
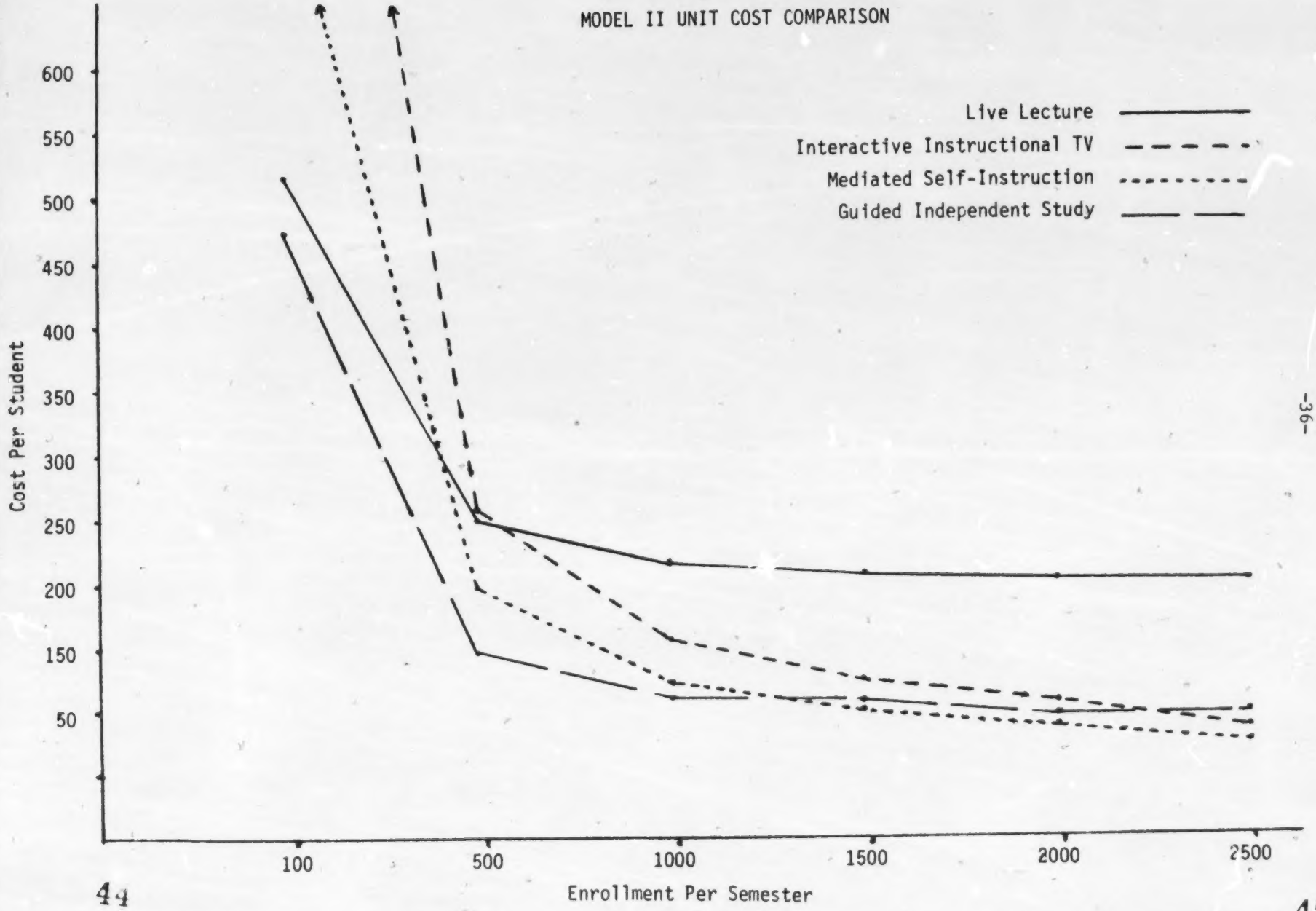


Figure 3

MODEL II UNIT COST COMPARISON



## Conclusion

The preceding material is an attempt to describe the conceptualization, methods, and some of the outcomes of one cost-effectiveness analysis of certain applications of instructional technology. Compared to other reported cost-effectiveness evaluations in this area, this study had some particular strengths and weaknesses. Overall, it was remarkable for its emphasis on portraying the specific circumstances of the decision situation it was designed to serve. This emphasis was reflected in such things as the development and use of multiple criteria, and various design decisions such as the choice to use neither a fixed cost nor fixed effectiveness approach. However, this emphasis also contributed to some possible weaknesses in the study. For example, the study's broad scope limited the attention that was given to addressing any one criterion, and the multiple criteria were never combined to form a final judgment of cost-effectiveness.[5]

This particular evaluation of cost-effectiveness has not been presented because of the immediate generalizability of its findings or methods. As discussed earlier, it has been reported because the literature in this area needs more examples of empirical investigations into instructional technology's cost-effectiveness. At present the conduct of such investigations is more art than science. To improve our ability to handle this art form we need practice and experience in its application. It is hoped that the report of this study can be added to others and used to inform future practice by suggesting new approaches to the investigation and new perspectives on the subject.

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[5] If this study was to be done again, consideration would be given to employing some of Edwards, Guttentag, and Snapper's (1975) suggestions on the decision-theoretic approach to evaluation research in producing specific cost-effectiveness judgments that would be responsive to the decision makers' points of view.

## Note

The author is currently engaged in conducting a meta-evaluation of previous attempts to evaluate instructional technology's cost-effectiveness. This meta-evaluation is being conducted to answer the following questions.

1) What are the major characteristics of cost-effectiveness studies of instructional technology?

2) How does the practice of cost-effectiveness analysis in this area compare with the models for conducting such studies?

3) What is the worth of existing attempts to determine the cost-effectiveness of instructional technology?

4) Can a model or models be developed depicting the major variables in the conduct of cost-effectiveness studies of instructional technology?

5) How can the methods of cost-effectiveness analysis be improved to meet the demands of this kind of evaluation situation?

Answers to these questions will be derived through an examination of those investigations that have been reported as dissertations, appear as articles or books, or are accessible through ERIC or NTIS services. If you know of some unpublished or inaccessible studies of instructional technology's cost-effectiveness that should be considered in this meta-evaluation, please contact me at the address below. Any comments or reactions you have to this report would also be welcome.

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